Brazil's Fiscal Incentive System and the Northeast:
An Econometric Analysis

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1. Introduction

Since the introduction in the early 1960's of the Article 34/18 fiscal incentives for private investment in the Brazilian Northeast, both the fiscal incentive system and the Northeast's economy have undergone diverse changes.[1] The changes in the fiscal incentive system have been the expansion of the system's benefits to other regions and economic sectors and two changes in the system's operational structure. The regions and sectors which have benefited from the expanded coverage include the Amazon (1963), the forestry (1966), tourist (1966) and fishing (1967) sectors, the state of Espírito Santo (1969), and the purchase of stock in the government's aeronautics firm, EMBRAER (1969).[2] The changes

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2 Throughout this article the following acronyms will be used when referring to the individual fiscal incenvite programs:

SUDENE, Progam for the Northeast region;
SUDAM, Program for the Amazon region;
IBDF, Program for the forestry/reforestation sector;

in the system's operational structure were the introduction of the PIN/PROTERRA "taxes" on the incentive deduction in 1970/71 and the switch to the mutual fund administration of the system in 1974.[3]

The Northeast's total income (gross regional product) grew at an average annual real rate of 6.8% while real per capita income grew at an average annual rate of 4.2% over the period 1960 to 1977(Table 1). Even though these growth rates are above average when compared with other countries, they have not been sufficient to prevent a decline in the Northeast's relative position vis-a-vis the entire nation or the non-Northeastern portions of Brazil. Two further points are clear from Table 1; the Northeast's growth rate has been more stable than the national growth rate; and during the periods of rapid national growth (1960/62, 1968/74, 1975/77) the Northeast's relative position has declined, while during the periods of slow national growth (1963/67, 1974/75, 1976/77) the Northeast's relative position has improved. These points indicate that the Northeastern economy has been relatively isolated from the national economy's growth cycle.

These observations concerning the changes in the fiscal incentive system and the behavior of the Northeastern economy suggest the following three questions:

(1) Why has the Northeast's relative income (total and per capita) declined over the years 1960 to 1977?
(2) Why has the growth of the Northeast's economy exhibited less variability than the national economy's growth, resulting in the observed countercyclical pattern of the Northeast's relative position? and
(3) What have been the effects of the changes in the fiscal incentive system on the Northeast's relative position?

In this paper the results of two regionally disaggregated models, used to address these questions, are presented.[4] The

SUDEPE, Program for the fishing sector;
EMBRATUR, Program for the tourism/tourist sector;
GERES, Program for the state of Espírito Santo; and
EMBRAER, Program for the government's aeronautics firm.

3 See Harber (1982), Chapter Three, for a more detailed discussion of these changes.

4 Previous studies dealing with these fiscal incentive programs have either been descriptive studies or concerned with microeconomic issues such as the allocational distortions

Table 1

NORTHEAST AND BRAZILIAN GROWTH RATES AND THE NORTHEAST'S PER CAPITA INCOME SHARE

	Average Annual Real Growth Rates			
	Northeast		Brazil	
Period	Total Income	Per Capita Income	Total Income	Per Capita Income
1960-77	6.82	4.22	7.56	4.48
1960-62	5.38	2.83	7.70	4.65
1962-67	6.21	3.64	3.17	0.30
1967-74	7.42	4.80	11.22	7.99
1974-75	7.39	4.77	5.71	2.81
1975-76	6.69	4.07	9.21	5.92
1976-77	8.21	5.57	4.70	1.64

	Northeast's Per Capita Income Relative to Per Capita Income in:					
	Brazil			Non-Northeast Brazil		
Period	Beginning of Period	End of Period	Change	Beginning of Period	End of Period	Change
1960-77	33.34	31.97	-1.37	25.49	24.93	-0.56
1960-62	33.34	32.15	-1.19	25.49	24.54	-0.95
1962-67	32.15	37.93	5.78	24.54	29.74	5.20
1967-74	37.93	30.73	-7.20	29.74	23.76	-5.98
1974-75	30.73	31.34	0.61	23.76	24.31	0.55
1975-76	31.34	30.77	-0.57	24.31	23.87	-0.44
1976-77	30.77	31.97	1.20	23.87	24.93	1.06

Sources: BNB, FIBGE.

primary motivation of both models is to evaluate the third of the above questions; however, their results also provide the basis for partial answers to the first two questions. In section two the issue of how to model the fiscal incentive system is discussed since this ques-

created by the incentive programs' implicit capital subsidy. Further, these studies have dealt with only one incentive program, rather than with the fiscal incentive system. See Harber (1982), Chapter Four, for a discussion of these studies. For a detailed review of the literature dealing with the regional incentive programs see Jatobá (1979).

tion is the principal problem encountered in constructing a macroeconomic model including this system. Sections three and four discuss the two models; a two region aggregate demand model is presented in section three, while a longer-run potential output model is presented in section four. Finally, section five summarizes the work, its results and conclusions.

II. Modeling the Fiscal Incentive System: Some Basic Considerations

The essence of Brazil's fiscal incentive system is the creation of a set of captive capital markets for the regions and sectors benefited by the programs. This system can be visualized through a supply and demand framework; the supply of incentive funds comes from a variety of income tax deductions, while the demand for the incentive funds comes from the private business community and their investment projects. Both sides of this captive capital market benefit since the taxpayers supplying the funds receive an abatement of their tax liabilities plus the possibility of a return from the invested funds, while the originators of the investment projects benefit through the lower costs of their projects and the spreading of the projects' risks across a larger group of individuals. Furthermore, there is a probable social gain since the programs attract investments to regions and sectors of the economy where external benefits are believed to exist, so that total benefits exceed private benefits.

The key question involved in the construction of macroeconomic models including the fiscal incentive system is how this system is to be modeled. This question can be divided into two parts — the incentive tax deductions and the incentive-induced investments. The incentive deductions may be treated as a special "tax," the proceeds of which are placed in a special "fund" and used to "subsidize" investment projects. This treatment may lead to a variety of spcifications for the incentive-tax function which include not only general form of the function but also the choice of variables to be included. As a first approximation, the incentive-taxes (TI) are assumed to be a function of income (Y), such that

$$TI = TI(Y),\ 0 < TI' = dTI/dY < 1.$$

The incentive-tax revenues can be viewed as being channelled

into a special fund which serves a double function. First, it links the incentive deduction process to the subsidized investments by providing the resources which are used as investment subsidies; second, it imposes a short-run dynamic structure on the model since there is generally a lag between the time when the deductions enter the fund and when they are distributed to the investment projects. This dynamic process is characterized as follows: let Z(t) be the stock of incentive funds available for use in period t, TI be the current incentive deductions, and a be the fraction of the currently available funds which are disbursed per period, $0<a<1$; by definition the stock of incentive funds available in period t is equal to the stock available in period t-1 plus the current incentive-tax deductions less the disbursements in period t-1, i.e.,

$$Z(t)=Z(t-1)+TI-aZ(t-1)$$

or $Z(t) = WZ(t-1) + TI$ (2)

where $W = 1-a$ = the fraction of the stock of fiscal incentive funds available, but not disbursed in period t-1, $0<W<1$.[5]

The modeling of the incentive-induced investments presents a wider range of options. One approach is to follow neoclassical microeconomic theory by postulating production and cost functions and then deriving an investment demand function in terms of relative factor prices and expected product demand. The effects of the fiscal incentive system are then introduced through the calculation of the distortion of the cost-of-capital generated through the incentive subsidies. This is the approach which has been used by the majority of the microeconomic studies dealing with the question of employment creation through the fiscal incentive programs.[6]

The approach used below is based on the structural characteristics of the incentive programs rather than this capital-subsidy method. The stock of the available fiscal incentive funds (Z) is one

5 An alternative approach would be to totally disaggregate the incentive system, specifying separate tax deduction functions and stocks of incentive funds for each program. Even though such disaggregation could yield interesting results, they would come with the cost of increasing the size and complexity of the model. The basic principles concerning the relationships involved in this approach, however, would be the same as those discussed in the text.

6 For examples of studies using this type of analysis see Goodman et. al. (1971) and Jatobá (1977).

of the determinants of the incentive-induced investment, while the various parameters established by the agencies administering the fiscal incentive programs form the remaining determinants. Varying degress of disaggregation are possible ranging from the consideration of each program separately to the complete aggregation of all programs into a single super-program. The method adopted here is to divide the programs into three groups according to their basic operational characteristics. The first group is composed of those programs (SUDENE, SUDAM, SUDEPE, EMBRATUR, GERES) which disburse the incentive funds in stages as their projects are implemented, and which only provide partial subsidies to their projects so that a project's total investment is a multiple of the incentive funds used in the project. The second group is composed of the IBDF program which also provides a partial subsidy to its projects, but only makes a single disbursement of incentive funds. The third and final group consists of the EMBRAER progam which provides a full (100%) subsidy and makes a single disbursement of incentive funds.

The incentive-induced investment function can now be developed. Suppose the stock of available incentive funds in a given time period for the i^{th} group is Z_i. If these programs only disburse a portion of their funds per period, their disbursed incentive funds would be given by L_iZ_i, where L_i is the disbursement rate (the fraction of available incentive funds disbursed per time period) for these programs, $0 < L_i < 1$. Further, if the group i programs provide only partial subsidies to their projects, each unit of disbursed incentive funds generates an amount of investment which is a multiple of the disbursed incentives, i.e., $m_iL_iZ_i$, where m_i is the project-investment multiplier for the group i programs (equal to the inverse of their average subsidy rate), $m_i \geq 1$. Since the level of incentive-induced investment is to be expressed as a function of the total stock of available incentive funds, Z, rather than as a function of the stock available for each group assume that each group's available incentive funds are proportional to the group's share of total approved incentive investment. If α_i represents group i's share of total approved investment, this assumption implies that $Z_i = \alpha_iZ$, and group i's realized incentive-induced investment would be $\alpha_im_iL_iZ$.

Using this last expression to define the realized investment of all the groups and summing over $i = 1, 2, 3$, results in the following expression of the level of incentive-induced investment (II):

$$\Pi = (\alpha_1 m_1 L_1 + \alpha_2 m_2 L_2 + \alpha_3 m_3 L_3)Z.$$

This equation can be simplified by recalling that by the groups' definitions,
$L_2 = L_3 = m_3 = 1$. Using this fact and setting $L_1 = L$, yields

$$\Pi = (\alpha_1 m_1 L + \alpha_2 m_2 + \alpha_3)Z$$

or $\Pi = MZ$ (3)

where $M = \alpha_1 m_1 L + \alpha_2 m_2 + \alpha_3 =$ the aggregate incentive-investment multiplier, $M > 0$; and

$\Sigma\alpha_k = 1$, $k = 1,2,3$.

The fraction of the stock of incentive funds available but not disbursed can now be defined in terms of these parameters. The value of the disbursed incentive funds in any period is given by $ZD = (\alpha_1 L + \alpha_2 + \alpha_3)Z$. Thus, the value of the non-disbursed incentive funds is $Z - ZD = \alpha_1(1-L)Z$ so that $W = \alpha_1(1-L)$.

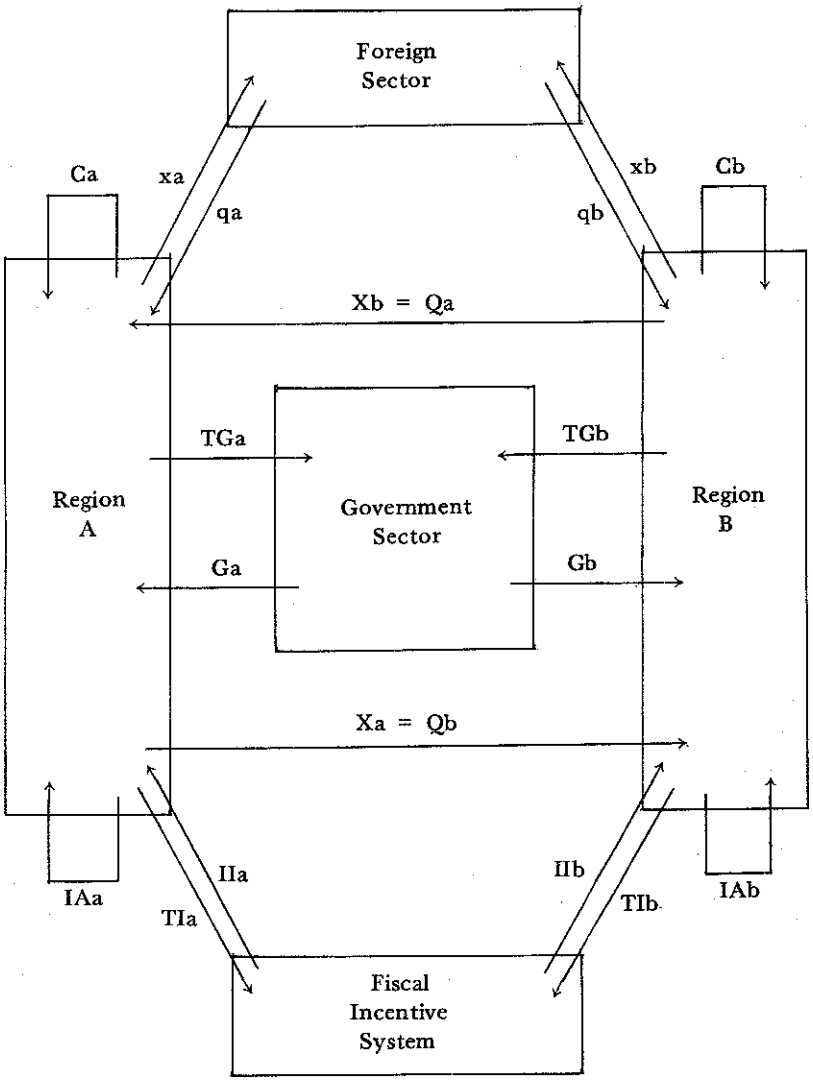
The considerations up to this point have led to the formulation of three relationships (equations 1, 2, and 3) necessary to model the fiscal incentive system. These relationships play a central role in the models presented below. The major changes of these relationships to be made all deal with the necessities of disaggregating the functions to apply to a two region model.

III. A Two Region Aggregate Demand Model

In this section an aggregate demand model including the fiscal incentive system is presented. The model is composed of two regions, A and B, interacting with each other through interregional trade and with the foreign sector through international trade. Two additonal sectors are included which act as intermediaries: a government sector which receives tax revenue and purchases goods and services from the two regions; and the fiscal incentive system. The model's basic flow relationships are illustrated in Figure 1.

The model is composed of nine structural equations (Table 2) whose specifications are consistent with the standard Keynesian aggregate demand model; two definitions; and an equilibrium condition for each region; plus a two region version of the

Figure 1
DIAGRAM OF PRODUCT FLOWS IN THE TWO REGION AGGREGATE DEMAND MODEL



Key of Variables' Definitions:

i = a, b = Regional Index
Ci = Region i's Consumption
IAi = Region i's Autonomous Investment
IIi = Region i's Incentive-Induced Investment
Gi = Government Expenditures in Region i
TGi = Government Taxes in Region i
TIi = Incentive Taxes in Region i
Xi = Region i's Regional Exports
Qi = Region i's Regional Imports
xi = Region i's Foreign Exports
qi = Region i's Foreign Imports

Table 2

STRUCTURAL EQUATIONS OF THE TWO REGION AGGREGATE DEMAND MODEL*

Equilibrium Conditions: $Yi = Ci + Ii + Gi + xXi - Qi + xi - pi$	(7)
Definitions of Disposable Income: $YDi = Yi - Ti$	(8)
Consumption Functions: $Ci = Ci(YDi)$, $0 < Ci' < 1$	(9)
Government Revenue Functions: $TGi = TGi(Yi, \xi i)$, $TGi_2 < 0 \quad TGi_1 < 1$	(10)
Incentive Tax Functions: $TIi = TIi(Yi)$, $0 < TIi' < 1$	(11)
Total Tax Functions: $Ti = TGi + TIi = Ti(Yi, \xi i)$; $Ti_2 = TGi_2 < 0 < Ti_1 = TGi_1 + TIi' < 1$	(12)
Investment Functions: $Ia = IAa + IIa = IAa + \zeta MZ(t)$, $0 < \zeta < 1$	(13a)
$Ib = IAb + IIb = IAb + (1-\zeta)NZ(t)$	(13b)
Government Expenditure Functions: $Ga = \gamma G$, $0 < \gamma < 1$	(14a)
$Gb = (1-\gamma)G$	(14b)
Regional Import Functions: $Qi = Qi(YDi)$, $Qi' > 0$	(15)
Regional Export/Import Balances: $Xi = Qj$; $i, j = a, b$; $i \neq j$	(16)
Foreign Export Functions: $xi = xi(YF, e, \xi i)$; $xi_1, xi_2, xi_3 > 0$	(17)
Foreign Import Functions (Foreign Currency): $qi = qi(YDi, e)$, $qi_2 < 0 < qi_1$	(18)
Foreign Import Functions (Domestic Currency): $pi = eqi = pi(YDi, e)$, $pi_1 > 0$	(19)
Available Incentive Funds: $Z(t) = WZ(t-1) + TIa + TIb$	(20)

Key for previously undefined parameters and variables:

- ξi = degree of export subsidy in Region i
- ζ = Region A's share of the disbursed incentive funds
- γ = Region A's share of total, exogenous government expenditures(G)
- e = exchange rate (domestic currency per unit of foreign currency)
- M(N) = Region A's (B's) aggregate incentive-investment multiplier
- M = $\alpha_1 m_1 L + \alpha_2 m_2 + \alpha_3 > 0$; N = $\beta_1 n_1 J + \beta_2 n_2 + \beta_3 > 0$
- W = $\zeta\alpha_1(1-L) + (1-\zeta)\beta_1(1-J)$

* All variables are measured in real terms. The following notation is used: For functions of a single variable, a prime (′) represents the function's total derivative, e.g., if $y = y(x)$, then $y' = dy/dx$. For functions of two or more variables, the partial derivatives are indicated by numerical subscripts, e.g., if $y = y(x,z,)$, then $y_1 = \partial y/\partial x$ and $y_2 = \partial y/\partial z$.

stock-flow relationship defining the available fiscal incentive funds. The exceptions to the standard specifications of the structural equations involve modifications which have been made to accommodate the inclusion of the fiscal incentive system (equations 9, 10a, 10b and 17), Brazil's export incentive programs (equations 7,

9 and 14) and an assumption that total government expenditures (G) are distributed between the two regions in fixed proportions (equations 14a and 14b).

For purposes of empirical analysis the model is expressed in linear form and estimated using Three Stage Least Squares (3SLS) and data from the period 1960-1977. Region A is identified as the Northeast, while Region B is the rest-of-Brazil. The values of the fiscal incentive parameters are calculated from data collected by the author from the agencies administering the incentive programs.[7] Data for the remaining variables are drawn from official sources such as FIBGE, SUDENE and *Conjuntura Econômica*.[8]

The regional parameter estimates are given in Table 3, while the values of the fiscal incentive parameters are shown in Table 4.[9] The values of the impact and long-run income multipliers for both regions are given in Table 5.[10] Except for a change in the Northeast's share in government expenditures (γ) and disbursed incentive funds (ζ), the regional multipliers have the same signs, and the absolute value of the multipliers for the Northeast are less than the multipliers for the rest-of-Brazil. This implies that a change in any exogenous or policy variable (except γ and ζ) will produce greater

7 See Harber (1982) for the data and procedures used to calculate these parameters.

8 Data is not available for regional consumption expenditures which necessitates a two step procedure to estimate the model's parameters. A similar model for Brazil was estimated using 3SLS to find the estimate of the national marginal propensity to consume from disposable income. If this estimate is C' and region A's share of national disposable income is α, then the regional marginal propensities to consume (Ca', Cb') are related to the national marginal propensity to consume by $C' = \alpha Ca' + (1-\alpha)Cb'$. This relationship can be used to find the various combinations of Ca' and Cb' which are consistent with C'. Due to the respective "levels of development" of the two regions, the restriction that $Cb' \leqslant Ca' \leqslant 1$ is imposed to limit these combinations. The remaining regional parameters are estimated within a system excluding the regional consumption functions. This process yields consistent estimates of the regional parameters; however, there is a loss of efficiency if the error terms of the regional consumption functions are contemporaneously correlated with the error terms of the remaining equations.

9 Two sets of fiscal incentive parameters are given in Table 4. The values listed as Full Period values refer to the entire 1963 through 1977 period. The Post '67 values are based upon the years 1968 through1977, the period following the system's expansion. The differences between these values reflect the changes induced by this expansion.

10 The Full Period values of the fiscal incentive parameters were used to calculate these multipliers; however, different combinations of alternative values for the regional consumption propensities and the two sets of fiscal incentive parameters were also used. Even though these different combinations slightly change the multipliers' specific values, they do not alter the conclusions stated in the text.

Table 3

ESTIMATED PARAMETER VALUES AND THE RATIO OF THE ESTIMATED VALUES TO THEIR STANDARD ERRORS — Z
(A = NORTHEAST; B = REST-OF-BRAZIL)

Parameter	Estimated Values	Z
Ca'	1.000	36.50
TGa_1	0.164	14.61
TGa_2	835.8	0.89
TIa'	0.008	11.28
Qa'	0.686	10.39
xa_1	1751.0	1.97
xa_2	-410500.0	-1.08
xa_3	64090.0	1.03
pa_1	0.143	9.88
pa_2	257000.0	2.08
Cb'	0.995	36.50
TGb_1	0.177	16.11
TGb_2	182300.0	3.38
TIb'	0.013	12.25
Qb'	0.008	8.41
xb_1	13310.0	4.30
xb_2	253900.0	0.19
xb_3	578600.0	5.35
pb_1	0.145	8.17
pb_2	-764200.0	-0.42
γ	0.05	

effects in the non-Northeastern regions than in the Northeast — even if the changing variable is a direct expenditure in the Northeast! The principal cause of this "unbalanced" pattern of the multipliers is the extreme difference in the regional import propensities Qa' and Qb'.[11]

These multipliers can be used to evaluate the effects of policies on the Northeast's relative position and the level of national in-

11 Even if Qa' is reduced by thirty percent and Qb' is increased by thirty percent, the multipliers maintain this unbalanced pattern. These thirty percent changes should be sufficient to cover any bias in the estimated parameters due to possible data quality problems.

Table 4

FULL PERIOD AND POST '67
PARAMETERS OF THE FISCAL INCENTIVE SYSTEM
(A = NORTHEAST; B = REST-OF-BRAZIL)

Parameter	Full Period	Post '67
Region A		
m_1	2.6414	2.6013
m_2	1.5861	1.5861
α_1	0.9987	0.9880
α_2	0.0113	0.0120
α_3	0.0000	0.0000
L	0.1789	0.1789
ζ	0.4783	0.4748
M	0.4899	0.4751
Region B		
n_1	2.0028	1.9943
n_2	1.8665	1.8665
β_1	0.6344	0.6278
β_2	0.3387	0.3432
β_3	0.0269	0.0290
J	0.0924	0.0924
$1-\zeta$	0.5217	0.5252
N	0.7765	0.7853
National		
W	0.6926	0.6844

come. The estimated percentage changes in the Northeast's income share and national income resulting from a one percent increase of total government expenditure (G), the Northeast's share of government expenditures (γ) and the Northeast's share of the disbursed incentive funds (ζ) are shown in Table 6. It it clear that changes in the two Northeastern share variables (γ and ζ) are the policies which should be used if the Northeast's income share is to be increased; however, these policies produce only minimal positive effects on national income, while an increase in government expenditures produce a substantial increase in national income, but aggravates the level of regional inequality. This situation creates an obvious conflict for policymakers in the formulation

Table 5

VALUES OF INCOME MULTIPLIERS

Change in Yi. with Respect to a Change in:	Impact Region A	Impact Region B	Long-Run Region A	Long-Run Region B
IAa	1.1856	2.1547	1.2102	2.3086
IAb	0.0344	3.2319	0.0616	3.4022
G	0.0920	3.1780	0.1191	3.3475
γ^*	1.1511	-1.0772	1.1542	-1.0936
ξa	74092.5	116497.0	75477.1	125163.7
ξb	12986.8	1371564.2	24523.2	1443772.5
e	-756281.4	1852384.7	2939.1	1923046.4
YF	2534.0	46782.6	2890.2	49318.1
$m1+$	0.1003	0.1823	0.1024	0.1953
$m2+$	0.0064	0.0116	0.0065	0.0125
L^+	1.4809	2.6914	1.5116	2.8837
$n1+$	0.0011	0.0988	0.0019	0.1040
$n2+$	0.0061	0.5711	0.0109	0.6012
$J+$	0.0228	2.1423	0.0409	2.2552
$\alpha 1+$	-0.6314	-1.1476	-0.6445	-1.2296
$\alpha 2+$	0.6314	1.1476	0.6445	1.2296
$\alpha 3+$	0.2991	0.5436	0.3053	0.5824
$\beta 1+$	-0.0302	-2.8351	-0.022	-2.9844
$\beta 2+$	0.0302	2.8351	0.0522	2.9844
$\beta 3+$	0.0146	1.3741	0.0262	1.4465
$\zeta+$	0.2656	-0.8122	0.5479	-0.2736

* Reported values should be multiplied by the level of government spending to find the full change in either region's income.

\+ Reported values should be multiplied by the level of nondisbursed incentive funds (Z) to find the full change in either region's income.

of policies to achieve both adequate growth and regional balance.

Another implication for regional policy is the need for measures to change the model's structural parameters, especially to reduce the difference between the regional import propensities. Such a change would generate a reduction in the differences between the regional multipliers allowing the Northeast to have a greater participation in the overall growth of the economy; thereby

Table 6

ESTIMATED EFFECTS OF A ONE PERCENT INCREASE OF SELECTED POLICY VARIABLES ON THE NORTHEAST'S INCOME SHARE (Ya/Y) AND NATIONAL INCOME(Y)

Policy Variable	Percentage Change of: Ya/Y Impact	Ya/Y Long-Run	Y Impact	Y Long-Run
G	-0.4606	-0.4460	0.6540	0.6933
γ	0.1121	0.1125	0.0007	0.0006
ζ	0.0661	0.1073	-0.0115	0.0058

reducing the countercyclical movements of the Northeast's relative position over the economy's growth cycle. Further, such measures would ease the policymakers' dilemma by improving the "terms of trade" between the growth and regional balance objectives.

The need to change values of the regional import propensities implies that the criticisms, advanced by Goodman (1972) and by Goodman by Cavalcanti (1974), that the Article 34/18 incentive program replicated the Center-South's industrial structure within the Northeast, ignoring regional comparative advantages, may be misdirected.[12] If this replication resulted in regional import substitution or regional export expansion by the Northeast, and if the value of the regionally imported inputs necessary to support the new productive structure is less than the value of the resulting production, then the replication of the Center-South's industrial structure through the Article 34/18 program would result in either a decrease of the Northeast's regional import propensity or an increase of the rest-of-Brazil's regional import propensity; thereby reducing the gap between the growth transmission from the rest-of-Brazil to the Northeast, and from the Northeast to the rest-of-Brazil.

These multipliers may also be used to evaluate the effects of the changes in the fiscal incentive parameters following the 1966/67 expansion of the incentive system on the Northeast's relative posi-

12 See Goodman (1972), pages 242-250, and Goodman and Cavalcanti (1974), pages 219-334, for the development of this view.

tion and on national income. These changes caused a decline in the Northeast's income share, as well as an increase in national income (Table 7). The impact effects of these changes account for 70.8% of the observed decline in the Northeast's relative income between 1967 and 1977, while the long-run effects account for an additional 13.2%, or 84.0% of the observed decline. It is also clear that the change in Region B's aggregate incentive-investment multiplier (N) generated the greatest contribution to the increase in national income while also contributing heavily (51% and 41.9%, respectively, of the impact and long-run estimated effects) to the decline of the Northeast's income share.

Another possible use for these multipliers is to answer the question: What is the minimum value of the Northeast's share of the disbursed incentive funds which is consistent with an increase in

Table 7

ESTIMATED EFFECTS OF THE CHANGES IN THE FISCAL INCENTIVE PARAMETERS (M, N, ζ) DUE TO THE 1966/67 EXPANSION OF THE INCENTIVE SYSTEM ON THE NORTHEAST'S INCOME SHARE (Ya/Y) AND ON NATIONAL INCOME(Y)

	Actual Change in (Ya/Y)*	Estimated Change Due to Parameter Value Changes*	(2/1)×100%	Estimated Percentage Change in Y
	(1)	(2)	(3)	(4)
Impact				
Total	−2.28 p.p.	−1.614 p.p.	70.79%	9.005%
ΔM	— —	−0.277	12.15	−1.087
ΔN	— —	−0.824	36.14	9.217
Δζ	— —	−0.513	22.50	0.875
Long-Run				
Total	−2.28 p.p.	−1.916 p.p.	84.04%	8.191%
ΔM	— —	−0.279	12.24	−1.144
ΔN	— —	−0.803	35.22	9.774
Δζ	— —	−0.834	36.58	−0.439

* In percentage points (p.p.).

the Northeast's total or per capita income relative to the rest-of-Brazil? This question's answer is important since it provides a check on the previous analysis; also, it provides the information from which the change in the Northeast's share of the disbursed incentive funds necessary for an improvement of the region's relative position can be found.

An increase in the Northeast's (Region A) total income (Ya) or per capita income (ya) relative to that of the rest-of-Brazil (Region B) requires that

$$\hat{Y}a - \hat{Y}b > D \tag{21}$$

where $\hat{Y}i = \Delta Yi/Yi$ = the proportional change in region i's income;

$D = 0$ if an increase in relative total income is desired; or $(\hat{P}a - \hat{P}b)$ if an increase in relative per capita income is desired;

and $\hat{P}i = \Delta Pi/Pi$ = the proportional change in region i's population.

Let $gj(\zeta;I)$ and $hj(\zeta;I)$ respectively be region A's and region B's income multipliers for the j^{th} exogenous or policy variable (xj), where I is the set of other parameter values. It then follows that

$$\Delta Ya = \Sigma_j gj(\zeta;I)\Delta xj = \Delta xk\ \Sigma_j\ gj(\zeta;I)\ wj$$

and $$\Delta Yb = \Sigma_j hj(\zeta;I)\Delta xj = \Delta xk\ \Sigma_j\ hj\ (\zeta;I)wj$$

where $wj = \Delta xj/\Delta xk$ = the policy-intensity weight for variable j relative to variable k.

Substituting these expressions into equation 18 gives the condition for an improvement of Region A's position relative to Region B as a function of Region A's share of the disbursed incentive funds (ζ). The resulting inequality can then be solved for the minimum value of Region A's share of the disbursed incentive funds consistent with an improvement of Region A's relative position. That is, find

$$\zeta^* = f(\overline{Y},\ D,\ I,\ \Delta xk,\ w_1,\ w_2,\ \ldots\ w_n) \tag{22}$$

such that

$$\{\Sigma_J[\overline{Y}gj\ (\zeta^*) - hj(\zeta^*)]wj\}\Delta xk = D/Yb$$

and $$\{\Sigma_j[\overline{Y}gj(\zeta + \delta) - hj(\zeta^* + \delta)]wj\}\Delta xk > D/Yb$$

where $\overline{Y} = Yb/Ya$ and δ is a small positive number.[13]

The problem involved with this procedure is that the resulting value of ζ^* is a function of the policy-intensity weights. Due to this dependency a general analysis along these lines is not feasible since the value of ζ^* will vary along with the policy-intensity weights; thus, empirical results using this approach are not presented.[14] This is not to say, however, that this approach does not have its uses; for example, if one were given a set of proposed policy changes from which the policy-intensity weights could be found, this approach could be used to determine:

1) if the proposed policies improve or worsen Region A's relative position for the current value of ζ; i.e., whether $\zeta > \zeta^*$ or $\zeta < \zeta^*$; and
2) the change in ζ which would be necessary for the proposed policies to improve Region A's relative position if $\zeta < \zeta^*$.

IV. A Two Region Potential Output Model

The potential output model also assumes the existence of two regions, A and B, but is based upon the assumption that the factor limiting growth is productive capacity or capital, rather than an insufficiency of aggregate demand. The model concentrates on the effects of investment upon the growth of potential or full-capacity output; therefore, it is in the tradition of the "Harrod-Domar" growth models developed in the late 1940's and 1950's.

The model is composed of the nine structural equations given in Table 8, while the results from the model's solution are shown in Table 9.[15] Equations 26 and 31 can be used to answer the question

13 When the long-run multipliers are used to find ζ^*, both a maximum and a minimum values result since equation 18 is then a quadratic function in ζ.

14 The interested reader can refer to Harber(1982), Chapter Seven, for an example of the empirical results of this approach. It should also be noted that by following a similar line of reasoning a second minimum and/or maximum value of region A's share of the disbursed incentive funds (ζ^{**}) could be found which would be consistent with the achievement of a given minimum national growth rate. This ζ^{**} value could then be used along with the ζ^* value to examine the consistency of proposed policies with the goals of reducing regional inequality and achieving the given minimum national growth rate.

15 Equations 23.a and 23.b are the definitions of regional per capita income which are used to derive the expressions in equations 26 and 27 for the per capita and total income dif-

Table 8

STRUCTURAL EQUATIONS OF THE TWO REGION POTENTIAL OUTPUT MODEL

Definitions of Per Capita Income:	$ya = Ya/Pa = (\alpha/\beta)y$	(23.a)
	$yb = Yb/Pb = (1-\alpha)/(1-\beta)y$	(23.b)
Harrod-Domar Income-Capital Stock Relationship	$Yi = (1/ki)Ki$	(24)
Definition of the National Capital-Output Ratio in terms of the Regional Captial-Output Ratios	$k = \alpha ka + (1-\alpha)kb$	(25)
Definitions of Incentive-Induced Investment:	$IIa = \zeta MZ$	(26.a)
	$IIb = (1-\zeta)NZ$	(26.b)
Definitions of Total Investment	$Ii = (1 + \theta i)IIi$	(27)

Key to Variable and Parameter Definitions

- Yi = Region i's income
- Pi = Region i's population
- y = National per capita income
- yi = Region i's per capita income
- α = Region A's share of national income
- β = Region A's share of national population
- k = National capital-output ratio
- ki = Region i's capital-output ratio
- Ki = Region i's capital stock
- Ii = Region i's total investment
- IIi = Region i's incentive-induced investment
- θi = the ratio of non-incentive-induced (private) investment to incentive-induced investment in Region i

ferential growth rates $\hat{y}d$ and $\hat{Y}d$, respectively. Equation 24 gives the standard Harrod-Domar equation relating total income to the capital stock through the average capital-output ratio; these relationships are used to derive the expressions in equations 30, 30.1 and 30.2 for the differential growth rate of total income. The definitional relationship between the national and regional capital-output raios given in equation 25 is used to derive equation 31 defining the growth rate of region A's capital-output ratio in terms of the growth rates of the national and region B's capital-output ratios and the differential growth rate of total income. Substituting equation 31 into equations 30, 30.1 and 30.2 and simplifying yields equation 32. Equations 26.a, 26.b and 27 complete the model by defining the levels of incentive-induced and total investment. Substitution of these equations into equation 32 gives the final solution for the differential growth rate of total income shown in equation 33.

Table 9

RESULTS FROM THE SOLUTION OF THE TWO REGION POTENTIAL OUTPUT MODEL+

$$\hat{y}d = \hat{y}a - \hat{y}b = \hat{y}d = (1/1 = \beta)\hat{\beta} \tag{28}$$

$$\hat{Y}d = \hat{Y}a - \hat{Y}b = (1/1-\alpha)\alpha \tag{29}$$

$$\hat{Y}d = \hat{Y}d_1 + \hat{Y}d_2 \tag{30}$$

$$\hat{Y}d_1 = \left\{(1-\alpha)\,Ykb\right\}^{-1} \quad \left\{(1-\alpha/\alpha)(kb/ka)Ia - Ib)\right\} \tag{30.1}$$

$$\hat{Y}d_2 = \hat{k}b - \hat{k}a \tag{30.2}$$

$$\hat{k}a = (k/\alpha ka)\hat{k} - (1-\alpha/\alpha)(kb/ka)\hat{k}b - (1-\alpha/ka)(ka-kb)\hat{Y}d \tag{31}$$

$$\hat{Y}d = (ka/k)\hat{Y}d_1 + (1/\alpha)(\hat{k}b - \hat{k}) \tag{32}$$

$$\hat{Y}d = (1/\alpha k)(Z/Y)\left\{(1+\theta a)\zeta M - (\alpha/1-a)(ka/kb)(1+\theta b)(1-\zeta)N\right\} + (1/\alpha)(\hat{k}b - \hat{k}) \tag{33}$$

$$\zeta^*(Yd) = \frac{(kY/Z)(1-\alpha)\,kb\,(\hat{k}-\hat{k}b) + \alpha ka\,(1+\theta b)\,N}{(1-\alpha)\,kb\,(1+\theta a)\,M + \alpha ka\,(1-\theta b)\,N} \tag{34}$$

$$\zeta^*(YID) = \frac{(kY/Z)(1-\alpha)\,kb\,(\hat{k}-\hat{k}b) + \alpha kaN}{(1-\alpha)\,kbM + \alpha kaN} \tag{35}$$

$$\zeta^*(yd) = \frac{(kY/Z)(1-\alpha)\,kb \quad (\alpha/1-\beta)\,\hat{\beta} + \hat{k} - \hat{k}b \quad + \alpha ka\,(1+\theta b)\,N}{(1-\alpha)\,kb\,(1+\theta a)M + \alpha ka\,(1+\theta b)\,N} \tag{36}$$

$$\zeta^*(yId) = \frac{(kY/Z)(1-\alpha)kb\left\{(\alpha/1-\beta)\,\hat{\beta} + \hat{k} - \hat{k}b\right\} + \alpha kaN}{(1-\alpha)\,kbM + \alpha kaN} \tag{37}$$

+ The following notation is used: For any variable x, $\hat{x} = (1/x)(dx/dt)$ = the growth rate of x.

which the aggregate demand model could not: What is the minimum value of the Northeast's share of the disbursed incentive funds (ζ^*) which is consistent with an increase in the Northeast's relative position?

Indentifying Region A as the Northeast, the necessary and sufficient condition for an increase in its relative position is that the differential growth rate of per capita or total income is positive, i.e., $\hat{y}d > 0$ or $\hat{Y}d > 0$. The choice between these two conditions depends upon whether per capita or total income is used as a measure of the Northeast's relative position. In addition to this choice, it is possible to choose whether to include or to exlcude the non-incentive-induced investment in the analysis. This possibility is useful since it

provides a way to identify whether the non-incentive-induced investment helps or hinders the desired change in the regional income distribution. Equations 34 through 37 give the expressions for the Northeast's minimum share of the disbursed incentive funds consistent with an increase in its relative position for these four cases. Equations 34 and 35 use total income to measure the Northeast's relative position, while equations 36 and 37 use per capita income. Equations 34 and 36 are based upon the inclusion of the non-incentive-induced investment, while equations 35 and 37 exclude it from the analysis. For all cases it is necessary that $\zeta > \zeta^*$ for the Northeast's relative position to improve.

There are thirteen parameters which determine the value of the Northeast's minimum share of the disbursed incentive funds necessary to improve the region's relative position: the Norhteast's share of income and populaton (α, β); the growth rate of the Northeast's population share ($\hat{\beta}$); the national and regional capital-output ratios (k, ka, kb); the regional aggregate incentive-investment multipliers (M, N); the ratio of non-incentive-induced investment to incentive-induced investment for each region (θa, θb); the ratio of national income to available incentive funds (Y/Z); and the growth rates of the national and non-Northeastern capital-output ratios ($\hat{k}$, $\hat{k}$b).

The estimated values of these parameters are given in Tables 4, 10, 11 and 12. The income and population shares and the growth rate of the Northeast's population share are the average values for the period 1960 to 1977 and were calculated from FIBGE and SUDENE data. The value for the ratio of national income to available incentive funds was estimated by using equation 2 and the dynamic equilibrium assumption that:

$$Z(t)/Y(t) = Z(t-1)/Y(t-1) = Z/Y$$

The values of the regional capital-output ratios (ka, kb)(Table 11) should only be considered rough estimates derived in the following manner. Using data for the period 1949-1977 the marginal capital-output ratio for Brazil in each year was computed. This ratio remained relatively constant with an average value of approximately 3.3. Due to this ratio's relative constancy, assume that the average capital-output ratio is also approximately 3.3 with a zero or near zero growth rate, i.e., $k \simeq 3.3$ and $\hat{k} \simeq 0$. Since this estimate of the national capital-output ratio is uncertain,

a range of values from 3.2 to 3.5 for this ratio, equation 23, the regional income shares, and the restriction that $kb \geqslant ka \geqslant 2$ were used to find the reported values of the regional capital-output ratios.

Table 10

ESTIMATED VALUES OF THE NORTHEAST'S INCOME AND POPULATION SHARES (α, β), THE GROWTH RATE OF THE NORTHEAST'S POPULATION SHARE ($\hat{\beta}$), AND THE RATIO OF INCOME TO AVAILABLE INCENTIVE FUNDS (Y/Z)

Parameter	Value
α	0.1025
β	0.3050
$\hat{\beta}$	-0.0042
Y/Z	22.6

Table 11

RANGES FOR REGIONAL CAPITAL-OUTPUT RATIOS FOR DIFFERENT NATIONAL CAPITAL-OUTPUT RATIOS

National Capital-Output Ratio	Range of regional Capital-Output Ratios	
k	ka	kb
3.20	2.062	3.33
	3.200	3.200
3.25	2.000	3.400
	3.250	3.250
3.30	2.004	3.440
	3.300	3.300
3.35	2.037	3.500
	3.350	3.350
3.40	2.087	3.550
	3.400	3.400
3.45	2.049	3.610
	3.450	3.450
3.50	2.011	3.670
	3.500	3.500

The range of values for the regional ratios of non-incentive-induced investment to incentive-induced investment (θa, θb) (Table 12) were estimated as follows: for Brazil the average value of this ratio (θ) was approximately 20 during the period 1963 to 1977; given this national value, the regional values (θa, θb) may be found from:

$$\theta = \gamma\theta a + (1-\gamma)\theta b,$$

where γ = the Northeast's share of total realized incentive-induced investment
$= 0.55$,
and the restriction that $(\theta b/\theta a) < 10$.

Table 12

POSSIBLE VALUES FOR THE RATIO OF PRIVATE TO INCENTIVE-INDUCED INVESTMENT

θa	4	to	20
θb	39.6	to	20

The remaining parameter value is the growth rate of the non-Northeastern capital-output ratio ($\hat{kb}$). Since information concerning this value is not available, assume that it is equal to the growth rate of the national capital-output ratio, i.e., $\hat{kb} = \hat{k}$. This assumption may be quite reasonable since the major portion of Brazil's productive capacity is located outside the Northeast.

Given these parameter values, the value of the minimum Northeastern share of the disbursed incentive funds consistent with an improvement of the Northeast's relative position can be found. Since the estimated capital-output and non-incentive-induced investment to incentive-induced investment ratios are expressed in ranges rather than point estimates, the ζ^* values (Tables 13 and 14) are also expressed in ranges. Examination of equations 34 through 37 shows that ζ^* will have its maximum (minimum) value when ka and θb take their maximum (minimum) values and kb and θa take their minimum (maximum) values; that is

$$\zeta^*_{max} = f(ka_{max}, kb_{min}, \theta a_{min}, \theta b_{max})$$

and $\zeta^*_{min} = f(ka_{min}, kb_{max}, \theta a_{max}, \theta b_{min})$.[16]

Table 13

RANGE OF THE MINIMUM NORTHEASTERN SHARE OF DISBURSED INCENTIVE FUNDS NECESSARY FOR A REDUCTION OF REGIONAL INEQUALITY. CALCULATED USING FISCAL INCENTIVE PARAMETERS OF 1963-1977 PERIOD

	National Capital-Output Ratio, k						
	3.20	3.25	3.30	3.35	3.40	3.45	3.50
ζ^*(YId)							
Minimum	0.1017	0.0943	0.0962	0.0962	0.0970	0.0940	0.0911
Maximum	0.1546	0.1546	0.1546	0.1546	0.1546	0.1546	0.1546
ζ^*(yId)							
Minimum	0.0191	0.0098	0.0106	0.0092	0.0088	0.0042	-0.0003
Maximum	0.0768	0.0756	0.0744	0.0732	0.0720	0.0708	0.0695
ζ^*(Yd)							
Minimum	0.1017	0.0943	0.0962	0.0962	0.0970	0.0940	0.0911
Maximum	0.5975	0.5975	0.5975	0.5975	0.5975	0.5975	0.5975
ζ^*(yd)							
Minimum	0.0978	0.0903	0.0922	0.0920	0.0928	0.0897	0.0867
Maximum	0.5901	0.5900	0.5899	0.5897	0.5895	0.5895	0.5894

Comparing the actual Northeastern share of the disbursed incentive funds (ζ) to the range of values necessary for a reduction of regional inequality, two conclusions may be drawn. First, when only incentive-induced investment is considered, the Northeast's share of the disbursed incentive funds has been sufficient to generate a reduction of regional inequality in terms of both total and per capita income since the actual share exceeds the maximum value of the minimum share necessary for a reduction of regional inequality, i.e., $\zeta > \zeta^*_{max}$. Second, when total investment is considered, it is impossible to reach a strict conclusion regarding the effects on regional inequality since the Northeast's actual share of the disbursed incentive funds is contained within the critical

16 The ζ^* values given in Table 13 were calculated using the Full Period incentive parameters while those given in Table 14 were calculated using the Post '67 values.

range, i.e., $\zeta^*_{min} < \zeta < \zeta^*_{max}$. This implies that the Northeast's relative position could be increasing, not changing, or decreasing depending on the "true" capital-output ratios and the regional levels of non-incentive-induced investment.

Table 14

RANGE OF THE MINIMUM NORTHEASTERN SHARE OF DISBURSED INCENTIVE FUNDS NECESSARY FOR A REDUCTION OF REGIONAL INEQUALITY. CALCULATED USING FISCAL INCENTIVE PARAMETERS OF 1968-1977 PERIOD.

	National Capital-Output Ratio, k						
	3.20	3.25	3.30	3.35	3.40	3.45	3.50
ζ^*(YId)							
Minimum	0.1039	0.0964	0.0984	0.0983	0.0992	0.0961	0.0931
Maximum	0.1578	0.1578	0.1578	0.1578	0.1578	0.1578	0.1578
ζ^*(yId)							
Minimum	0.0197	0.0102	0.0110	0.0096	0.0093	0.0045	-0.0001
Maximum	0.0786	0.0774	0.0761	0.0749	0.0737	0.0725	0.0712
ζ^*(Yd)							
Minimum	0.1039	0.0964	0.0984	0.0983	0.0992	0.0961	0.0931
Maximum	0.6033	0.6033	0.6033	0.6033	0.6033	0.6033	0.6033
ζ^*(yd)							
Minimum	0.0999	0.0923	0.0942	0.0941	0.0949	0.0917	0.0886
Maximum	0.5959	0.5958	0.5956	0.5955	0.5954	0.5953	0.5952

The similarities among the critical ranges for the different captial-output ratios indicate that the principal determinant of whether or not regional inequality will be reduced when total investment is considered is the level of non-incentive-induced investment in each region. Utilizing the relationships derived above and the Northeast's actual share of the disbursed incentive funds, the maximum value of the ratio of non-incentive-induced (private) investment in Region B to private investment in Region A consistent with a reduction of regional inequality can be found. Again due to the lack of knowledge regarding the exact values of the parameters, it is only possible to find ranges for this ratio. The level of private investment in Region B can range from 3.2 to 6.6 (3.9 to 8.4) times larger than the level of private investment in Region A and still result in a reduction of regional inequality measured by

the total (per capita) income share (Table 15) when the full period fiscal incentive parameters are used; the limits on the private investment ratio decline to 3.0-6.0 for a reduction of inequality measured by per capita income (Table 16) when the Post '67 fiscal incentive parameters are used.

Table 15

RANGE OF MAXIMUM PRIVATE INVESTMENT RATIO FOR A REDUCTION OF REGIONAL INEQUALITY TO OCCUR GIVEN THE OBSERVED VALUE OF THE NORTHEAST'S SHARE OF DISBURSED INCENTIVE FUNDS. CALCULATED USING FISCAL INCENTIVE PARAMETER VALUES FOR 1963-1977 PERIOD.

	National Capital-Output Ratio, k						
	3.20	3.25	3.30	3.35	3.40	3.45	3.50
$\hat{Y}d$							
Minimum	3.2272	3.2272	3.2272	3.2272	3.2272	3.2272	3.2272
Maximum	5.6537	6.2647	6.0938	6.1010	6.0256	6.2938	6.5769
$\hat{y}d$							
Minimum	3.9449	3.9564	3.9679	3.9935	3.9910	4.0025	4.0140
Maximum	7.0373	7.8601	7.6604	7.6948	7.6197	8.0023	8.4095

Table 16

RANGE OF MAXIMUM PRIVATE INVESTMENT RATIO FOR A REDUCTION OF REGIONAL INEQUALITY TO OCCUR GIVEN THE OBSERVED VALUE OF THE NORTHEAST'S SHARE OF DISBURSED INCENTIVE FUNDS. CALCULATED USING FISCAL INCENTIVE PARAMETER VALUES FOR 1968-1977 PERIOD.

National Capital-Output Ratio, k							
	3.20	3.25	3.30	3.35	3.40	3.45	3.50
$\hat{Y}d$							
Minimum	2.9743	2.9743	2.9743	2.9743	2.9743	2.9743	2.9743
Maximum	5.1929	5.7492	5.5937	5.6003	5.5317	5.7757	6.0330
$\hat{y}d$							
Minimum	3.6522	3.6630	3.6739	3.6847	3.6956	3.7065	3.7174
Maximum	6.4902	7.2422	7.0605	7.0925	7.0245	7.3742	7.7462

These results indicate that the changes in the fiscal incentive parameters following the 1966/67 expansion reduced the likelihood that a reduction of regional inequality will occur since the maximum private investment ratio consistent with a reduction of regional inequality is lower when the Post '67 incentive parameters are used than when the full period parameters are used.

V. Summary and Conclusions

In this article the effects of Brazil's fiscal incentive system on the Northeast were examined using two macroeconomic models. Although other questions were discussed, the principal concern was to evaluate the effects of the 1966/67 extension of the fiscal incentive system's benefits to the forestry, tourist and fishing sectors on the degree of regional inequality between the Northeast and non-Northeast regions.

Since macroeconomic models including the fiscal incentive system had not been previously constructed, the basic characteristics of this system and their implications for modeling the system within a macroeconomic framework were first examined. The first model presented is a two region aggregate demand model, while the second model is a two region Harrod-Domar potential output model.

Three questions derived from an examination of data for the period 1960 to 1977 were posed in the introductory section. Answers to these questions may now be given based upon the results of the models developed above:

(1) What have been the effects of the changes in the fiscal incentive system on the Northeast's relative position?

The analysis in section three indicated that the changes in the incentive system's parameters due to the system's 1966/67 expansion led to a worsening of the Northeast's relative position and explained approximately 84% of the observed decline in the region's income share. The conclusion that these changes worsened the Northeast's relative position is also supported by the results in section four where it was shown that the maximum private investment ratio consistent with an increase in the Northeast's relative position declined as a result of the parameter changes.

(2) Why has the growth of the Northeast's economy exhibited less variability than the growth of the national economy over the course of the recent growth cycle, resulting in the observed countercyclical pattern of the Northeast's relative position?

In section three it was shown that the regional income multipliers have an unbalanced pattern, so that the effects of economic policies and changes in exogenous variables are larger in the non-Northeast region than in the Northeast. This pattern implies that the effects of the changes occurring over the course of a growth cycle will be smaller for the Northeast than for the economy as a whole; thus, the Northeast's growth rate will be less variable than the national growth rate. The observed countercyclical pattern of the Northeast's relative position is a natural outcome of this process. This view is buttressed by the facts that the Northeast is responsible for less than ten percent of Brazil's industrial production, and that the industrial sector has been the leading sector of Brazil's recent growth cycle; thus, the initial impacts of the industrial fluctuations are much greater outside the Northeast, than within the region.[17]

(3) Why has the Northeast's relative income (total and per capita) declined during the 1960 to 1977 period?

The problem of responding to this question is that there is an overabundance of possible answers. Among them are:

(a) The effects of the fiscal incentive system's expansion;
(b) A combination of policies and exogenous shocks which have worked against the Northeast through the unbalanced multipliers; and
(c) Insufficient private investment in the Northeast relative to private investment in the rest-of-Brazil, so that the actual private investment ratio exceeded the maximum private investment ratio consistent with an improvement in regional inequality given the incentive system's parameters.

Clearly this list does not exhaust the possible explanations and

17 See Harber (1982), Chapter Two.

these and other explanations are not mutually exclusive. In fact, it is quite likely that a complete explanation for the observed decline would include not only these possibilities, but also a variety of others.

The above analysis and discussion has tended to be critical of the fiscal incentive system in the sense that the focus has been on the system's contributions to the decline in the Northeast's relative income. It should be remembered, however, that the Northeast's annual average real growth rate during this period was 6.8%, while per capita income was growing at an annual real rate of 4.2%. These growth rates imply that the Northeast's income was doubling every ten to eleven years, while its per capita income was doubling every sixteen to seventeen years. There can be little doubt that the capital transfers through the incentive system, totalling CR$390 billion in 1980 prices, increasing the Northeast's industrial capital stock by an estimated 400%, have made significant contributions to these growth rates.

In conclusion it should be remembered that the analysis presented in this article is only the first step in evaluating the maçroeconomic effects of Brazil's fiscal incentive system. The models used are relatively simple in their conceptual structure and exclude a number of important phenomena and constraints, such as inflation, the balance of payments, credit and monetary conditions, the role of expectations and uncertainty, etc. Due to these limitations, further research is needed to extend and improve the analysis at both the national and regional levels.

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